GEOMETRIC SCALE EFFECT OF MICRO FLOW CHANNELS IN MINIATURE FUEL CELLS

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Micro fuel cells have been drawing increasing attention in response to the great demand for power solutions in portable electronics. Microfabrication techniques have been adapted in an effort to miniaturize fuel cells, and accordingly silicon has been the material of choice for micro fuel cell components - especially flow structures [1,2]. However, even though silicon boasts a richness of well-established processes with high resolution, expensive resources and long cycle time pose a limitation to widespread investigation of microscale fuel cell phenomena, such as transport behavior in microchannels. Alternatively, low-cost fabrication and rapid prototyping with structural photopolymer presents a more flexible option. Microchannels based on such materials have been successfully integrated into fuel cell devices with appreciable performance [3].

This paper will discuss the use of direct photopolymer processing to enable studies of geometric scale effect on microchannels in miniature fuel cells. The microchannels based on photosensitive epoxy-based material (SU-8) are finely patterned using photolithography. Subsequently, metal layers are vapor deposited on the surface for current collection. Figure 1. shows such a structure made of SU-8 with gold layer. Microchannels with different feature sizes are integrated into fuel cell prototypes and tested for comparison. Also, the performance is discussed in relation to geometric parameters. Figure 2. shows the initial performance data of fuel cells with different feature sizes. Three-dimensional numerical analysis is also applied to offer explanations for the results observed in the studies.

1. S. C. Kelley, et al,*Micro-Power Sources*, The Electrochemical Society Proceeding Series, Pennington, NJ (2000).
2. S.J. Lee et al, J. Power Source, 112 (2002)
3. S.W. Cha et al, in The Electrochemical Society, Philadelphia, PA(2002)

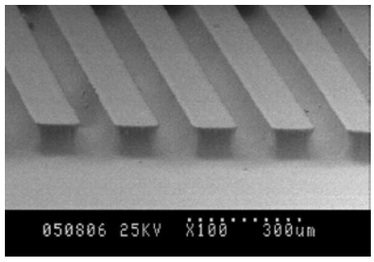

Figure 1. SU-8 microchannels with gold current collector for miniature fuel cell

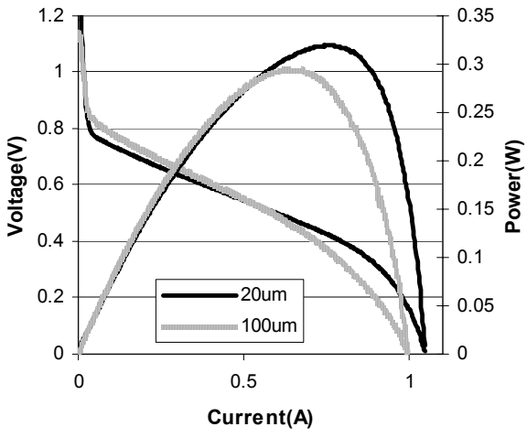

Figure 2. Initial performance result of miniature fuel cell with SU-8 microchannels of different feature size.